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MESOZOIC VOLCANICS FROM DELENI-6042 AND OTHER DEEP WELLS IN THE TRANSYLVANIAN DEPRESSION AND THEIR RELATION TO THOSE FROM THE SOUTH APUSENI MTS. (ROMANIA)

Corina IONESCU[1] & Volker HÖCK[2]

[1] Department of Mineralogy, Babes-Bolyai, 1 Kogalniceanu Str., RO-400084 Cluj-Napoca, Romania, corinai@bioge.ubbcluj.ro
[2] Department Geography, Geology and Mineralogy, University of Salzburg, 34 Hellbrunnerstrasse, A-5020, Salzburg, Austria, volker.hoeck@sbg.ac.at

Introduction

The Transylvanian Depression in Romania (TD) contains a number of gas fields, which were frequently drilled. Only a small number of drill holes penetrated the pre-Cenozoic formations, from which even less reached the Mesozoic volcanics. Among those, one, named 6042-Deleni, was set up in the northern part of the major Deleni gas-bearing structure. Initially it was planned to reach a depth of 6000 m for the well, but finally it stopped at 5062 m in most likely Jurassic basaltic rocks. The whole stratigraphic range of the well involves Cenozoic (Sarmatian, Badenian) and Mesozoic (Cretaceous and Upper Jurassic) rocks (*Romgaz Archives, Medias*; unpublished data. The oldest rocks overlaying the volcanic sequence belong to the base of Kimmeridgian as exemplified by *Alveosepta jaccardi,* SCHRODT. More than 350m of basic volcanics were drilled; about 10% to 15% were cored in several intervals between 4702 and 5015.5m. Other drill holes, which reached the basaltic rocks, were 1-Cenade, half way between Blaj and Sibiu, 1-Zoreni in the northern third of the TD and 1-Jibert in the SE, north of Fagaras (Fig. 1). From these drill cores were made available to further petrographical and geochemical investigations by the courtesy of *Romgaz Medias*. In the TD several boreholes e.g. Ocna Mures, Viisoara, or Mihesu de Campie also reached the volcanics but no samples are available for research. Up to now, 20 samples from Deleni, four from Zoreni, one from Cenade and one from Jibert respectively were analysed. Thus, the in the following we will focus on the Deleni samples. The other analyses will be discussed shortly in addition.

Results

The volcanic sequence, drilled in Deleni between the depth of 4742 and 5015 m, is represented by massive lava flows. They are sometimes brecciated, in particular at the upper part of this drilling interval. The rocks are dark-coloured, blackish-greenish and show in general various degrees of alteration. The low T-P conditions of the hydrothermal alteration can be estimated from the presence of minerals such as albite, K-feldspar, glauconite, smectite, Fe-clinochlore, calcite (± iron oxides), chalcedony, and illite. Zeolites were found only as alteration products in clinopyroxene and plagioclase phenocrysts. The presence of yugawaralite indicates very low P-T conditions (acc. to Kiseleva *et al*., 1996), i.e. a formation close to the surface, while laumontite could have formed during the burial of the volcanic sequence in Tertiary times (Ionescu *et al.*, 2003).

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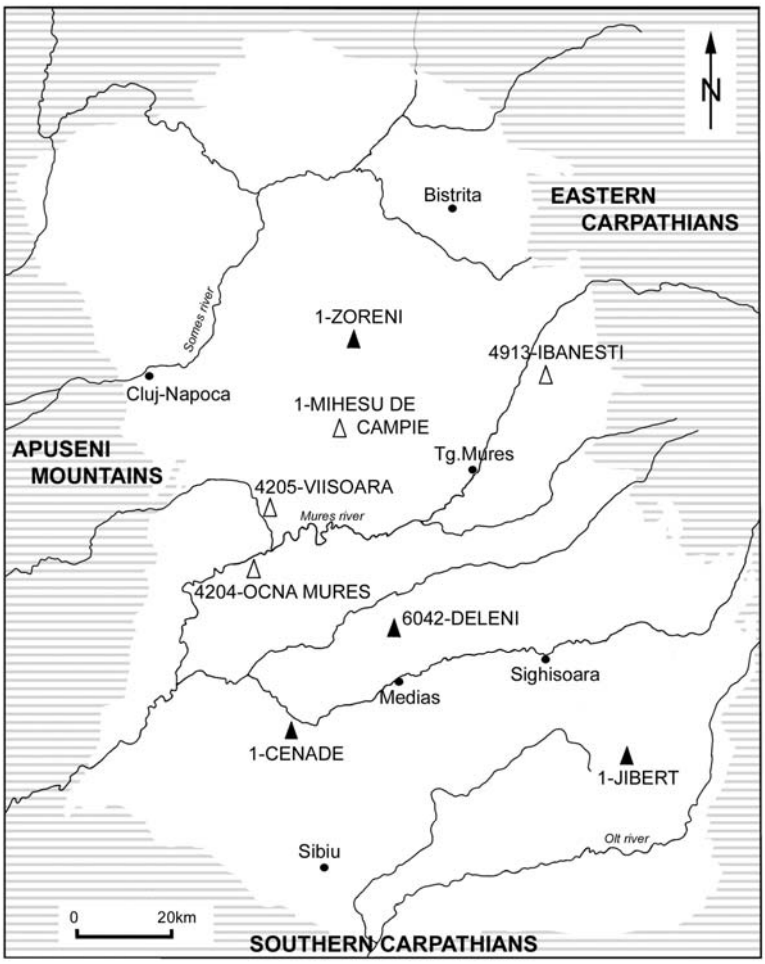

Fig.1: Sketch map of the Tansylvanian Depression with the position of the boreholes reaching the Mesozoic volcanics. Black triangles mark the sampled boreholes.

In general, the rocks are relatively poor in phenocrysts such as plagioclase and pyroxene. Plagioclase phenocrysts are zoned, with an anorthite rich core and bytownite at the rim. Zoned pyroxene phenocrysts revealed Mg-rich cores and Fe-rich rims. The micro-ophitic groundmass contains microphenocrysts of plagioclase, small grains of pyroxenes and opaque minerals and more or less altered glass. The texture is fluidal, with the orientation of the feldspars in the direction of the flow.

The volcanics classify as basalts, basaltic andesites and andesites with partly a low content of alkalies. Based on some trace elements as Cr, Zr and Ni and alkalies, three groups could be separated (Ionescu & Hoeck, 2004). They are:

Group A (lowermost): with low Cr, Ni and Zr as well as low alkalies;
Group B (middle): very high Cr and Ni/low Zr and alkalies;
Group C (uppermost): low Cr and Ni/high Zr and alkalies.

Other elements such as Rb, Y, Sr, Th, Ba etc. fit this grouping as well. The intensity of the alteration processes, as reflected by CO_2 and H_2O contents, is also different in the three volcanics groups: low in the lowermost level (A), increasing in the middle level (B) and high in the uppermost level (C) The analysis from Cenade fits quite well the basalts from Deleni. It is best comparable to Group B of Deleni. The Zoreni samples are highly altered and to a large extent carbonatized. Nevertheless, when normalized to a dry basis they are basaltic andesites

with high MgO, Cr and Ni, but very low Ti, Zr, Y and Sm. The REE patterns show a very slight depletion of the normalized middle REE. These features indicate some affinities for the Zoreni basaltic andesites to boninites.

The generally low contents of Zr, TiO_2, Y, the low Ti/V ratio (<20) as well as the boninitic affinities of the Zoreni volcanics argue for a formation of these basalts, basaltic andesites and andesites in a supra-subduction zone environment (Island Arc Volcanics). The high Th/Yb ratio as well as the high Ce/Yb ratio, combined with a relatively low Ta/Yb ratio, suggest a calc-alkaline nature of these volcanics. The REE distribution and the Spider diagrams indicate clear differences between the three groups, but all show in general the same calc-alkaline-SSZ features.

Conclusions

The volcanics (basalts, basaltic andesites, andesites) crossed by the deep wells 6042-Deleni in the centre, 1 Cenade in the southern part and 1-Zoreni in the northern part of the Transylvanian Depression exhibit clear calc-alkaline character, with IAV-SSZ features. Comparison with other basaltic and andesitic volcanics located towards west of Deleni deep well, in the South Apuseni Mountains, shows that the Deleni volcanics are obviously not genetically related with the ophiolitic basalts (MORB) described previously by Saccani *et al.* (2001), Bortolotti *et al*. (2002) and Nicolae & Saccani (2003), but they might be quite well compared with some IAV described by Nicolae (1995), Bortolotti *et al.* (2002) and Nicolae & Saccani (2003) in the southern and southeastern parts of the Apuseni Mountains.

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